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NCRR:
A Catalyst for Discovery

A Plan for the National Center for Research Resources

National Institutes of Health

March 1994

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Acknowledgment

To the Biomedical Research Community:

It is our great pleasure to acknowledge the invaluable support and cooperation provided to the NCRR and its staff by the many hundreds of members of the entire biomedical and behavioral research community across the Nation. Together we have developed a flexible plan to be responsive to the needs of the scientific community.

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Introduction

NCRR's Mission: To serve as a "catalyst for discovery" for NIH-supported investigations throughout the Nation.

We do this by creating, developing, and providing a comprehensive range of human, animal, technological, and other resources to enable biomedical research advances. NCRR promotes collaborations within and across scientific disciplines and provides quick, flexible approaches to new and emerging research needs.

The fulfillment of this mission, in alliance with our NIH partners, will convert the promise of better health for our Nation's citizens into reality.

The greatest challenges facing the National Center for Research Resources (NCRR) in fulfilling its mission are to keep abreast of rapidly evolving trends in basic and clinical research and to respond by offering scientists supported by the National Institutes of Health (NIH) a comprehensive range of tools and materials critical to their research efforts.

To tackle these challenges, NCRR has undertaken an interactive, open planning process in partnership with the broad scientific community. This document reflects the considerable input from that community and provides guidance to NCRR and the NIH in making the difficult choices between many competing priorities in times of tight fiscal constraints.

Our first task was to understand the basic and clinical research trends that will drive the future need for resources and technologies. The task was awesome, as is the pace of modern biomedical discovery. Weekly we hear of the identification of new genetic linkages to disease, newly discovered molecules responsible for powerful biological function, or new noninvasive methods of diagnosing disease, such as imaging of tissues, organs, and even molecules. These promise soon to improve the quality of our health and to extend the average lifespan of our citizens.

To gain an understanding of future research trends and resource needs, we requested input from members of the scientific community. We received more than 600 responses from scientists and research administrators in 45 states. Based on this input, we designed and held a Scientific Forum at which representatives of NCRR's broad constituency further examined the choices and generated a set of recommendations that resulted in this plan for NCRR. Attendees at the Forum also addressed the difficult task of recommending criteria for setting priorities and achieving a balance in the NCRR portfolio of support.

When making difficult choices, NCRR must give priority to those projects for which it is the best or only source of support. United by the following characteristics, NCRR resources and technologies are:

- At the cutting-edge of innovation in technologies and research, including high-risk research that may have high payoff.
- Often one-of-a-kind, scarce, or expensive.
- Accessible and responsive to the research needs of the biomedical research community.
- Cost-saving, efficient, and shared.
- Multidisciplinary and collaborative, often serving to integrate diverse research efforts.
- Stable and flexible, allowing scientists to react rapidly and effectively to emerging research needs and unexpected opportunities.

NCRR will look to these attributes and continue to seek advice from the scientific community in charting its course for the future. We hope that our plan, "NCRR: A Catalyst for Discovery," will enable us to fulfill our vision of helping to convert scientific ideas into the reality of better health for our Nation's citizens.

Trends and Challenges in Biomedical Research

"What are the most important basic and clinical research trends that will drive NCRR's future research portfolio? Which technologies and resources will be critical?" The Center posed these questions to the scientific community at large in May 1993, through a notice in the *Federal Register* and a mailing to scientists nationwide. This marked the Center's first major step in its open, interactive planning process.

From 607 people in 45 states, NCRR received thoughtful, detailed responses that fully represented the diverse community served by the Center. Respondents included deans of medical, dental, and veterinary schools; presidents of professional societies; clinicians studying a broad range of human diseases; bench scientists from many disciplines; research veterinarians; and allied health professionals.

In brief, the respondents reported the following dominant research trends: molecular biology and molecular medicine; structural and cellular biology; imaging in biology, from molecules to intact organisms; and multidisciplinary approaches for both basic and clinical research. The respondents identified many resources needed to support these trends, including an array of biomedical research technologies, models, and materials; human resources; and improvements in our research environments, particularly at minority institutions. Many replies also focused on related issues in research support, policies, and communications.

These responses have been invaluable to NCRR. The input guided the design of an NCRR scientific forum titled "Choices and Challenges: Future Directions for NCRR," held in September 1993. At the forum 56 members of the scientific community further discussed the trends, needs, and issues, and developed the actions found later in this plan. Examples of the trends and challenges in biomedical research, distilled from the many voices of the scientific community, are provided below.

"The ability to use genetically engineered diagnostics and genetically derived therapeutic techniques will drive the next wave of biomedical development."

Within the next few decades the complete organization and structure of the human genome may be unraveled, thereby providing a more intimate understanding of the human body—its strengths and weaknesses. Advances in molecular biology and medicine have already demonstrated that the structures of individual genes and proteins provide new starting points for therapies to correct defects in regulation of the body's cellular machinery and organ systems. Molecular medicine is no longer a distant hope.

"The trend in both basic and clinical research involves intensifying efforts to realize the molecular level identification and to understand structure-function relationships for all normal physiological processes that maintain homeostasis, so as to decipher structural abnormalities that cause disease states."

Structural biology has expanded greatly in recent years from its initial focus on the study of protein structures. The field now includes studies of cellular recognition and the immune response, the molecular basis of gene regulation, the processes of viral infection and self-assembly, and the use of information about proteins and nucleic acids involved in disease processes to develop drugs to inhibit or prevent disease. The challenge to NCRR is to provide the resources, technologies, and training to sustain this momentum.

"Modern instrumentation makes unprecedented findings possible and accelerates the pace at which these discoveries are made.... Through the use of instrument-intensive techniques researchers are deeply entrenched in investigations that not only strive to unmask the underlying processes of life and disease, but also to develop instrumentation used to investigate and to treat disease. ...Of the many opportunities that lie ahead of the health-related research community, two of the most promising areas of research are molecular analysis and imaging techniques, especially those of a quantitative nature."

NCRR will continue to play a key role in the advancement of biomedical science by providing the critical technologies and instrumentation needed by the research enterprise. These resources are the foundation that provides the means for scientific achievements. By constantly assessing research trends and needs, NCRR programs will keep biomedical research at the cutting edge.

"One of the most important research goals of NIH, besides conducting research and supporting researchers, is to attract young scientists into research disciplines."

The support for research training that assists investigators to become independent scientists is critical. The NCRR has a special role to play across the continuum for human resource development: From piquing the interest of students in science to attracting and maintaining the participation of investigators from underrepresented groups in biomedical research, and supporting researchers to synergize collaborations and effectively transcend barriers across scientific disciplines.

"The thread that weaves together molecular therapeutics is a set of cross-cutting technologies that bridge departments and traditional disciplines."

NCRR-supported research takes place in a variety of settings ranging from offices equipped with state-of-the-art computers to clinical centers. New research techniques place surgeons in front of computers and computer specialists in the operating room. The changing demands of today's research environment require greater cooperation among scientists of different disciplines and will cause boundaries among some disciplines to be redrawn or disappear.

"A basic trend that will drive biomedical research will, paradoxically, be efforts at cost containment in health care. The current notion that 'costly technology' is a problem is, I believe, a short-sighted view.... Cost containment will force us to find simpler and more elegant ways to do very complex things."

By maintaining lines of communication with academic and industrial researchers, Government agencies, legislators, and the public, NCRR will constantly analyze new scientific developments and opportunities to build on our strengths. For example, the pending health care reform in the United States will broaden the requirements for studies on disease prevention, especially those associated with malnutrition, poor hygiene, and prenatal care. Improvements in the quality of life are certain to follow these efforts. The NCRR stands ready to participate in these studies, thereby helping to catalyze the advancement to better health for all Americans.

Objectives and Plans

Clinical Research

Ensure that the clinical research community has sufficient research resources to rapidly and effectively respond to current and emerging critical health issues.

Critical Technologies

Promote the development of and accessibility to novel and essential research tools and support cutting-edge technologies.

Research Models

Promote the development, availability, and accessibility of animal and nonanimal models for human health and disease.

Research Environments

Improve and maintain the Nation's biomedical research infrastructure.

Human Resources

Ensure the growth and strength of the Nation's scientific talent base.

Communication

Establish NCRR as a communication resource across the biomedical research community.

Strategic Alliances

Pursue strategic alliances with the institutes, centers, and divisions of NIH and other Federal organizations, academia, industry, and other interested groups to advance our mission and strengthen the biomedical community.

Management and Operations

Ensure that the administrative component of NCRR remains responsive to the needs of the scientific community.

Clinical Research

Objective: Ensure that the clinical research community has sufficient research resources to rapidly and effectively respond to current and emerging critical health issues.

The health of our Nation's citizens depends on vigorous clinical research teams that stand ready to evaluate and resolve emerging medical problems. Through its General Clinical Research Centers (GCRC's), NCRR catalyzes the transfer of technologies from the laboratory bench to the patient. Because the Nation's health care needs change rapidly and unpredictably, NCRR must stand ready to satisfy changing and future demands.

Plan:

New Opportunities

➤ ***Establish national gene therapy resources.*** Develop regional gene therapy laboratories to provide molecular research tools to clinical investigators. Such tools will include viral and other gene vectors, pharmaceutical-grade proteins, monoclonal antibodies, cell lines from humans and animal models, and improved reagents for assessing gene function in organisms.

➤ ***Meet the needs of underserved groups in clinical research.*** Encourage research centers to focus clinical studies on the health needs of underserved groups.

Modify Present Activities

➤ ***Poise GCRC's to meet new challenges created by health care reform.*** Convene conferences to address global clinical responses to these changes and to consider how initiatives such as gene therapy, preventive medicine, and outcomes research will be supported under these plans.

➤ ***Increase the flexibility of GCRC core laboratories.*** Evolve core laboratories from analytical to biological resources to promote interdisciplinary research.

➤ ***Place greater emphasis on studies of critically ill patients.***

➤ ***Enhance capacity to treat and study outpatients and to conduct multicenter studies with large patient populations.***

➤ ***Diversify the clinical investigator talent base.*** Encourage students at minority institutions to enter clinical research and enhance their clinical research environments.

Critical Technologies

Objective: Promote the development of and accessibility to novel and essential research tools and support cutting-edge technologies.

Advances in science and technology occur with breathtaking speed. Breakthroughs in nonbiomedical disciplines such as physics can have important implications for the study of biology or medicine, but first these discoveries or inventions must be translated for use in the health-related sciences. For example, the optical scanning microscope, used by physicists and engineers to analyze and design intricate electronic circuits, has recently proved to be a valuable tool in biology, enabling scientists to probe and manipulate the tiniest internal structures of the cell. NCRR recognizes that high-quality and innovative biomedical research depends on the availability of state-of-the-art technologies and research facilities.

Plan:

New Opportunities

➤ ***Promote innovative research to bridge the gaps between basic research, bioengineering, and clinical research.*** Include biosensors, tissue engineering and biomaterials, delivery systems for gene therapy, and therapeutic agents.

➤ ***Establish a program to support the development of high-risk innovative technologies.*** Address the need for more responsive and more flexible review and funding mechanisms; hold a conference to look at high-risk development options.

➤ ***Aid the development of a new generation of biosensors and actuators.*** Apply new micromachining and microelectronics technologies to this line of research.

Modify Present Activities

➤ ***Foster high-performance computing and communication (HPCC) research*** along with algorithm development. Assure that HPCC serves as an enabling technology to facilitate analysis of computer-intensive technologies.

➤ ***Balance funding for technology development*** to address issues such as technologies for studying problems of different scales (e.g., intact organisms vs. molecules) and support for established investigators vs. younger ones.

➤ ***Foster the development of technologies and instrumentation.*** Develop methods for identifying proteins and their structure and function in the cell; tools for improving gene sequencing at reduced costs; techniques for detecting and understanding the structure, function, and regulation of macromolecular assemblies, complex intact systems, and whole organisms; and methods for studying the dynamics of structures and processes.

➤ ***Encourage development of a new generation of hybrid biomaterials, tissues, and organs.*** Develop methods for assessing biocompatibility and detecting flaws in biomaterials.

➤ ***Encourage advances in noninvasive, in vivo imaging techniques and imaging systems that integrate multiple levels of scale.*** Develop improved software for imaging, upgrade obsolete equipment, develop new nonradioactive contrast agents, and develop improved methods for imaging dynamic processes.

Research Models

Objective: Promote the development, availability, and accessibility of animal and nonanimal models for human health and disease.

Much of our understanding of the human body in health and disease is based on basic and applied research performed on animal and nonanimal models. Using these models for human disease, researchers can conduct crucial experiments that would otherwise be impossible.

NCRR lends strength to the Nation's biomedical research community by supporting a broad range of model systems, including vertebrate models, invertebrate models, cellular models, mathematical models, and computer and physical models.

Plan:

New Opportunities

➤ ***Establish national genetic resources for research models.*** These resources will support the development of new animal models, embryonic stem cell lines, and related technological tools; preserve the germ plasm of valuable experimental models such as unique knockout strains and natural models in jeopardy of extinction; and aid in the cataloging and distribution of research models.

➤ ***Take the lead in technological development of transgenic animal models, especially in creating transgenic animals other than mice.*** Expand pathology activities to include evaluating lesions in transgenic animals and train postdoctoral fellows in transgenic technologies. Novel systems should also include nonmammalian models for biomedical research.

➤ ***Establish units for animal embryo cryopreservation,*** including whole embryo banks and embryonic stem cell lines. Provide linkage to a computer database for access by the NIH intramural and extramural communities. Include both research and service components in the resources. Establish advisory committees whose membership reflects all aspects of the resource activities for both intramural and extramural NIH scientists.

Modify Present Activities

➤ ***Promote development of cell-culture alternatives to animal models for screening for biocompatibility and product testing.***

➤ ***Foster the development of mathematical, computer, biological, and physical models that will illuminate developmental processes and biological function.***

➤ ***Acquire objective data on the appropriate care and treatment of laboratory animals.*** Such data will help to guide future regulatory decisions and may be obtained in collaboration with industry.

Research Environments

Objective: Improve and maintain the Nation's biomedical research infrastructure.

Infrastructure consists of the manner in which research is conducted, as well as tools, technologies, and stable, well-maintained state-of-the-art research environments. These environments require multidisciplinary research that integrates diverse research efforts, interests, ideas, and programs. In fostering such research, NCRR serves as a unifying force, bringing together complementary specialties and lines of investigation to advance of science.

NCRR supports specialized research and resource facilities, both on the NIH campus and at research institutions around the country. By supporting the construction and renovation of research facilities and ensuring the acquisition of appropriate research tools, NCRR fosters the growth of biomedical research. The shared research environments and instruments supported by NCRR are not only economical but also serve as a fertile ground for stimulating research and collaboration.

Plan:

New Opportunities

➤ ***Examine mechanisms for facilitating resource sharing, communications, and flexibility.*** Eliminate barriers between intramural and extramural resources, and forge stronger ties to the private sector.

➤ ***Consider developing an online model-building project for a scientific topic or disease system*** at different levels of organization, from the molecular level to whole organisms, populations, and the environment. This project will integrate the ideas of scientists from many disciplines.

➤ ***Foster technology transfer.*** Encourage interchange between basic researchers in appropriate technologies (such as imaging) and clinicians to ensure rapid transfer from the bench to the patient. Sponsor national conferences for this purpose and encourage the participation of biomedical engineers in this translation process.

Modify Present Activities

➤ ***Be a proactive partner with the institutes, centers, and divisions of NIH.*** Monitor the research directions of NIH components and direct funding toward meeting their research needs.

➤ ***Foster collaborations across NIH intramural and extramural boundaries.***

➤ ***Facilitate access to NCRR-supported facilities.*** Convene scientific forums to discuss issues of intramural and extramural access, and unmet needs.

➤ ***Expand the Shared Instrumentation Grant Program.*** This should be a high NCRR priority. Consider new guidelines to encourage innovation and stimulate interdisciplinary collaboration; require collaborative management of equipment, convenient access to equipment, and appropriate utilization standards and training.

➤ ***Foster the research goals of minority institutions.*** Examine the paradigm of NCRR's Research Centers in Minority Institutions Program to ensure its effectiveness and responsiveness.

➤ ***Promote the use of NCRR-supported research resources by investigators from minority institutions.***

➤ ***Emphasize the renovation of existing facilities,*** especially at minority institutions, animal facilities, and obsolete facilities for biomedical research.

Human Resources

Objective: Ensure the growth and strength of the Nation's scientific talent base.

Lofty goals for biomedical research mean nothing without a vigorous, diverse, and continuously renewed corps of well-trained investigators to advance the field. NCRR gives high priority to strengthening the Nation's human resources in science through three fundamental mechanisms: (1) NCRR fosters enthusiasm for science among students and their teachers in grades K–12 and encourages children to better understand and perhaps pursue careers in biomedical research; (2) NCRR increases the diversity of the biomedical community by providing essential research resources and education to underrepresented groups; and (3) NCRR empowers biomedical investigators by providing specialized training and essential research resources.

Future generations must be assured of a scientifically literate population and an adequate workforce of biomedical scientists. The decreasing interest in science and the uneven science education in the United States must be addressed to ensure that the American biomedical research enterprise retains its eminent position in the world.

Plan:

New Opportunities

➤ ***Provide mechanisms to familiarize basic, applied, and clinical researchers with state-of-the-art research and techniques that lie outside their field of specialty.*** This includes training in the use of advanced computational methods, structural biology, molecular biology, and biotechnology.

➤ ***Provide transition support to ease the financial burden of preparing for a research career during the period between fellowships and grant acquisition.*** Consider such options as longer duration of support for clinicians and veterinarians in training, as well as modified training or junior career development programs, salary hikes for the Clinical Associate Physician awards and other similar programs, forgiveness for training debts, and mentoring support.

Modify Present Activities

➤ ***Extend the Clinical Associate Physician (CAP) and Minority CAP award programs to ensure an adequate talent base of clinical investigators.*** The number of awards should at least equal the number of General Clinical Research Centers.

➤ ***Maintain and expand the number of research career awards, a crucial and unique source of funding, particularly for veterinary research.***

➤ ***Expand mentorship programs for biomedical researchers, especially for those from disadvantaged backgrounds.***

➤ ***Promote science literacy and public understanding of science.*** Develop and use modern educational techniques and computer networks to disseminate programs and ensure their wide use. Target students in grades K–12, female and minority students, and the public.

➤ ***Identify and pursue NCRR's unique role in expanding and coordinating existing science education programs.*** Focus on underserved students to encourage their interest in science. Create new, effective partnerships at NIH, within the Government, and among scientists and the general public to prevent duplication of efforts and to ensure wise expenditure of NCRR's scarce fiscal resources.

Communication

Objective: Establish NCRR as a communication resource across the biomedical research community.

Because of its interdisciplinary nature, NCRR is uniquely positioned to help expedite communications technology and training across and within scientific disciplines. Computer networks and software technologies are invaluable as enabling technologies to facilitate communication among researchers across the country and around the world and to analyze complex data sets as the data are collected.

Plan:

New Opportunities

- ***Establish online information networks and bulletin boards of NCRR resources to promote access and collaborations among the following groups:*** NIH-supported scientists; industry and basic researchers; basic and clinical researchers; bioengineers and clinical researchers.

- ***Establish online databases that facilitate the exchange of information in the following areas:*** A clinical database that identifies projects under evaluation, study site, and patient population; a biological imaging database for use by investigators in many fields; and a genetic resources database that describes the availability of and access to such resources as animal models, DNA from various species, and cell lines.

- ***Develop computer technologies for training.*** Such technologies include interactive television and other instructional approaches.

Modify Present Activities

- ***Develop and provide a variety of effective information sources and products to enhance access and appreciation for NCRR's resources.*** Target several audiences including biomedical investigators, universities and research institutions, professional societies, and NIH-related industries.

- ***Communicate to the public the importance and the limitations of nonhuman models for biomedical research.***

- ***Support development of user-friendly software and algorithms that are well documented and platform-independent.*** Areas of emphasis may include medical outcome evaluation and imaging and anatomical research. This specialty software may be distributed free (network-based accessibility) or at very low cost.

- ***Expand existing mechanisms for communications between basic and clinical researchers.*** Hold local, regional, and national meetings that coincide with already scheduled meetings, and symposia.

- ***Encourage interdisciplinary and interinstitutional collaborations and interactions.***

Strategic Alliances

Objective: Pursue strategic alliances with the institutes, centers, and divisions of NIH and other Federal organizations, academia, industry, and other interested groups to advance our mission and strengthen the biomedical community.

In today's climate of financial constraint and limited resources, it is imperative that organizations with similar interests join forces to foster scientific progress. Greater advances are achieved when groups work in concert rather than pursuing separate paths toward the same end. In the past NCRR has collaborated with the National Science Foundation, the National Aeronautics and Space Administration, the Department of Energy, and other Government agencies to aid the advancement of science. NCRR will continue in this capacity, actively exploring opportunities for forming partnerships with other organizations, including those in the private sector, to support and energize the scientific community.

Plan:

New Opportunities

➤ ***Form partnerships with industry to provide the academic community with training opportunities and better access to industry's facilities and equipment.*** Encourage collaborations among investigators at NCRR-supported General Clinical Research Centers, pharmaceutical firms, biotechnology firms, and national laboratories.

Modify Present Activities

➤ ***Form strategic alliances with other institutes, centers, and divisions of NIH.*** Be prepared to meet the needs of the other components of NIH through joint funding strategies or partnerships.

➤ ***Encourage collaboration and, where appropriate, more formal relationships with other Government organizations.*** Potential partners include the National Science Foundation; the Food and Drug Administration; the National Aeronautics and Space Administration; the National Institute of Standards and Technology; and the Departments of Energy, Defense, Agriculture, Commerce, and Veterans Affairs.

Management and Operations

Objective: Ensure that the administrative component of NCRR remains responsive to the needs of the scientific community.

By providing appropriate programs, funding mechanisms, and overall guidance, the administrative component of NCRR strives to empower the biomedical investigator. Although some of NCRR's programs and activities are congressionally mandated, NCRR can exercise considerable latitude in carrying out those functions. NCRR staff aspire to provide superior service to the biomedical community and will continuously evaluate options for improving management and operations.

Plan:

New Opportunities

- ***Create a program for novel, short-term research with an accelerated review process.*** This program may include 3-year award periods, high-risk projects with great potential for results, peer review that reaches beyond or circumvents accepted methodologies. Ensure inclusion of investigators who lack an extensive "track record" but have demonstrated exceptional scientific talent.

- ***Establish an outreach program at the NIH Library for intensive support of specific NIH projects (e.g., searching sequencing databases).*** Expand electronic access.

- ***Explore new medical arts and photography technologies for the visual display of information.***

Modify Present Activities

- ***Strengthen NCRR's existing resources.*** Resources and staff must respond rapidly to the changing needs of the biomedical research community.

- ***Continually examine the current resource paradigm.*** Ensure a balance among resources, collaborations, and services to facilitate research across intramural and extramural activities.

- ***Evaluate NCRR-supported resource centers and technologies as an ongoing activity.*** Evaluate centers in terms of their productivity, array of technologies, and their usefulness as a local, regional, or national resource.

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"Choices and Challenges: Future Directions for NCRR"—September 28–30, 1993

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